Site-Wide Proposed Plan for the Lawrence Livermore National Laboratory Site 300 Final Record of Decision

UCRL-AR-226111

United States Department of Energy • Livermore Site Office – May 2007

Introduction

The United States Department of Energy (DOE) requests public comments on this Proposed Plan for cleanup of contaminated soil and *ground water*[a] at the Lawrence Livermore National Laboratory (LLNL) Site 300 Experimental Test Facility. This Proposed Plan summarizes DOE's preferred final cleanup actions and cleanup standards for most areas of Site 300, and the rationale for identifying these preferred actions. The Proposed Plan was prepared in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (*CERCLA*, or Superfund). The CERCLA process and schedule for Site 300 is shown in Figure 1.

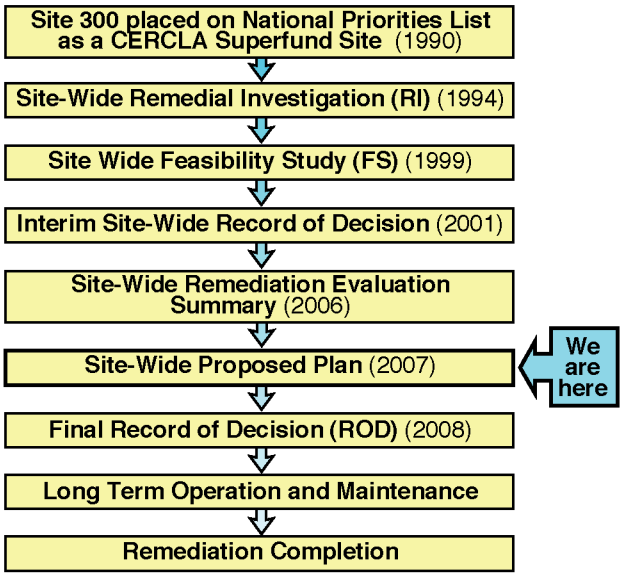

Figure 1. CERCLA Process and Schedule for Site 300.

This Proposed Plan covers the following *Operable Units* (OUs) at LLNL Site 300:

- Building 834 (OU 2).
- Pit 6 Landfill (OU 3).
- High Explosives Process Area (OU 4).
- Building 850 and Pit 7 Complex (OU 5).
- Building 854 (OU 6).
- Building 832 Canyon (OU 7).
- Site-Wide OU including Buildings 801, 833, 845, and 851, and the Pit 2, 8, and 9 Landfills (OU 8).

The General Services Area (GSA) (OU 1) is not included in this Proposed Plan because a final remedy and cleanup standards have already been selected in the GSA *Record of Decision* (ROD) in 1997. However, the specific *Institutional/Land Use Controls* for the GSA OU have been incorporated into this Proposed Plan.

DOE completed detailed environmental investigations at Site 300 to identify *contaminants of concern* that were released to the environment, the extent of contamination at the site, and risk to humans and plant and animal communities posed by the contamination. In 1999, DOE conducted a thorough screening and evaluation of possible interim cleanup alternatives, and interim cleanup remedies for OUs 2 through 8 were selected in the Interim Site-Wide ROD in 2001. An interim remedy for the Pit 7 Complex area was selected in an Amendment to the Interim Site-Wide ROD in January 2007.

Cleanup activities began at Site 300 in 1982. These cleanup activities were expanded after the Interim Site-Wide ROD was signed in 2001. In 2006, the Site-Wide Remediation Evaluation Summary report assessed the protectiveness and effectiveness of the cleanup actions specified in the Interim Site-Wide ROD and provided the basis for the preferred final cleanup actions described in this Proposed Plan.

How do I participate in the process?

DOE invites the public to attend a meeting at 6 p.m. on June 20, 2007 in the Tracy Community Center, 300 East 10th Street, Tracy, CA. Representatives from DOE, LLNL, U.S. Environmental Protection Agency (EPA), and the State of California will discuss the proposed cleanup plan and answer questions during the meeting.

A 30-day public review and comment period on the Proposed Plan begins on May 25, 2007 and ends on June 25, 2007. All interested members of the public are encouraged to review and comment on this document. You can submit your comments verbally at the public meeting or in writing. Written comments should be received by June 25, 2007 by:

Claire Holtzapple
Site 300 Remedial Project Manager
DOE/NNSA Livermore Site Office
Lawrence Livermore National Laboratory
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Livermore, CA 94550

[a] **Definition or descriptions of *italicized* words are provided in the Glossary on page 16.**

DOE and the regulatory agencies encourage the public to review and comment on the Proposed Plan during the 30-day public comment period that starts on May 25, 2007 and concludes on June 25, 2007. All comments received at the public meeting and during the public comment period will be considered prior to making a decision on the final cleanup actions and standards for Site 300.

Following the public comment period, DOE will select the final cleanup actions and standards for Site 300 and describe them in the Final Site-Wide ROD that will be submitted to the regulatory agencies for approval. All public comments will be addressed in a Responsiveness Summary section of the Final Site-Wide ROD. The Final Site-Wide ROD is scheduled to be completed in March 2008. DOE will provide an additional opportunity for public participation in this process during preparation of the Final Site-Wide ROD.

Role of the Regulatory Agencies

The U.S. EPA, the California Department of Toxic Substances Control (DTSC), and the Central Valley Regional Water Quality Control Board (RWQCB) provide guidance to DOE on the investigation and remediation of contaminants at Site 300. The regulatory agencies review and comment on all CERCLA compliance reports prepared by DOE, provide *applicable or relevant and appropriate requirements* for the site, review and evaluate remedial technologies and alternatives, participate in the selection of the final remedy, and provide oversight and enforcement of State and Federal environmental regulations. The regulatory agencies will actively participate in the public meeting for the Proposed Plan to monitor and review public acceptance of the proposed remedies.

Site Background and Characteristics

Site 300 is located in the Altamont Hills approximately 17 miles east of Livermore and 8.5 miles southwest of downtown Tracy (Figure 2). Site 300 is a restricted-access DOE experimental test facility used in the research, development, and testing of high explosive materials. Nuclear weapons have never been tested at Site 300, although *non-fissile* radioactive materials have been included in explosive components that are tested. Experiments began at Site 300 in 1955. A number of contaminants were released to the environment, primarily as a result of past waste handling procedures at the site. Operational and waste handling activities that resulted in these releases have been discontinued or modified to prevent further contamination. These releases primarily occurred from surface spills, leaching from unlined landfills and pits, high explosive test detonations, and past disposal of waste fluids in lagoons and dry wells. DOE began conducting environmental restoration activities at Site 300 in 1982. In 1990, the U.S. EPA placed Site 300 on the *National Priorities List* (Superfund). Since then, all investigation and cleanup activities have been conducted under regulations administered by the U.S. EPA and the State of California.

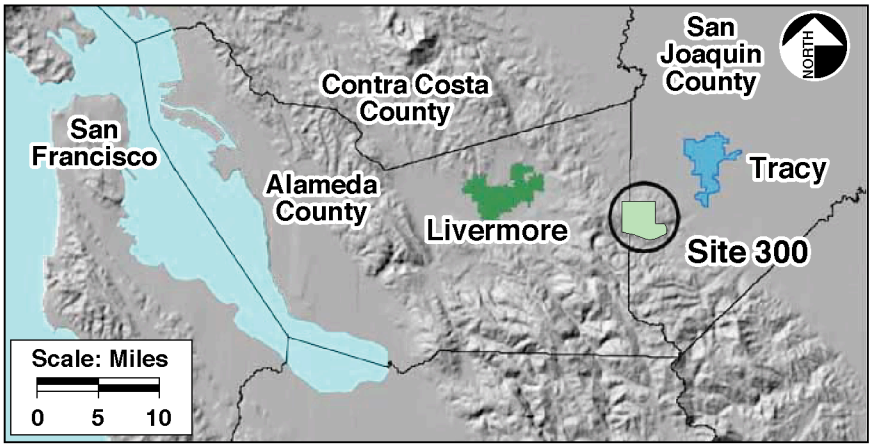

Figure 2. Location of LLNL Site 300.

What contaminants are present and where are they?

Environmental investigations identified 23 locations where contaminants were released to the environment. The contaminants of concern for OU 2 through 8 are shown on Figure 3. The primary contaminants at Site 300 include trichloroethylene (TCE) and other volatile organic compounds (VOCs), high explosive (HE) compounds, perchlorate, tritium, uranium, nitrate, polychlorinated biphenyls (PCBs), dioxin and furan compounds, the silicone oil, tetrabutyl orthosilicate (TBOS), and metals (see "What are the main contaminants at Site 300"). As shown on Figure 4, ground water contamination has resulted from some of these releases.

Definition or descriptions of *italicized* words are provided in the Glossary on page 16.

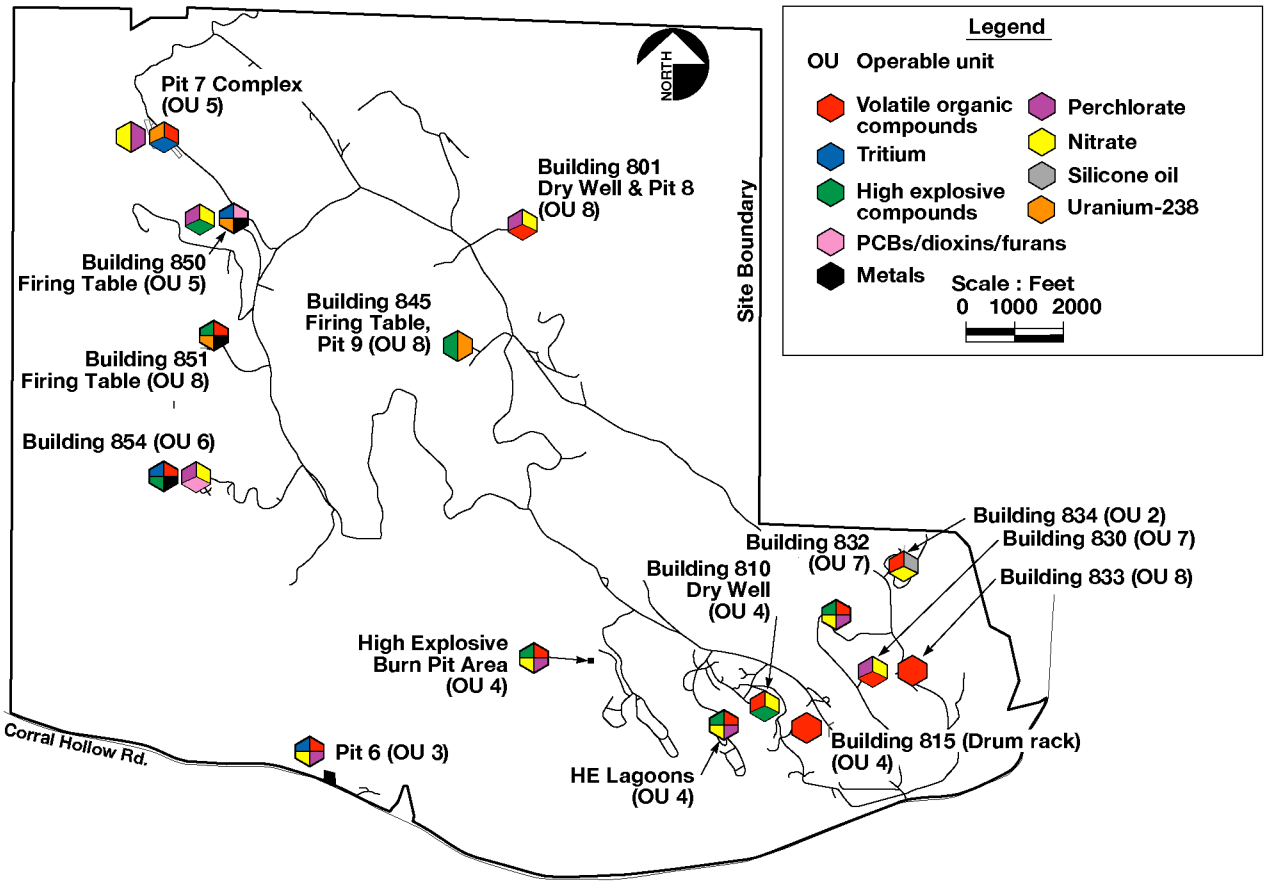

Figure 3. Contaminants of concern at Site 300 for surface soil, subsurface soil/rock, surface water, and ground water.

What are the main contaminants at Site 300?

1. Volatile Organic Compounds (VOCs) are chemical substances that evaporate readily into air. Solvents, gasoline, paint thinners, and nail polish remover contain VOCs. VOCs were used as degreasing solvents and as a heat-exchange fluid in experiments at Site 300 and were released by spills and piping leaks. Trichloroethylene (TCE) is the most common VOC found at Site 300. Many VOCs are suspected human carcinogens if inhaled or ingested.

2. High Explosive (HE) compounds (primarily RDX) are formulated and tested at Site 300. These compounds were present in rinsewater that was once placed in unlined ponds. RDX is a suspected human carcinogen if inhaled or ingested.

3. Perchlorate is used in high explosives. It is toxic if ingested, but is not a carcinogen.

4. Nitrate is: (1) a byproduct of HE processing and combustion, (2) found in septic system drainage, and (3) present naturally in the bedrock and soil at Site 300. Nitrate is not toxic to adults, but can cause health problems in infants. It is not carcinogenic.

5. Tritium is the common name for hydrogen-3, a radioactive isotope of hydrogen. Although tritium can be a gas, its most common form is in water. Tritium replaces one of the stable hydrogen atoms in the water molecule, H_2O, which is then called tritiated water. Like "normal" water, tritiated water can evaporate to the atmosphere as a gas. Although nuclear weapon testing has never been performed at Site 300, tritium was used in some of the high explosive experiments. Tritium was released during these detonations, and tritium-contaminated firing table debris was placed in unlined landfills and has leached into the ground water. Tritium naturally decays with a half-life of 12.3 years, and is a human carcinogen if inhaled or ingested.

6. Uranium is a radioactive metal that occurs naturally in soil and rock. Depleted uranium is natural uranium with the more radioactive uranium-235 isotope extracted leaving the less radioactive uranium-238 isotope. Depleted uranium is used in explosive tests at Site 300. Uranium was released from firing table gravels and unlined landfills. Uranium is a human carcinogen if inhaled or ingested.

7. Polychlorinated biphenyls (PCBs) and dioxin and furan compounds were contained in some of the equipment used for high explosive tests. The equipment was destroyed in the detonations, and PCBs and dioxin and furan compounds were found in the surrounding soil. PCBs and dioxin and furan compounds are human carcinogens if ingested or inhaled.

8. Tetrabutyl orthosilicate (TBOS) is a silicone-based lubricating oil that was mixed with TCE to preserve pump seals in heat-exchange piping systems.

9. Metals are elements found naturally in the environment or that may be associated with site activities. The metals beryllium, cadmium, copper, lead, and zinc have been detected in surface soil in some areas of the site at levels above those that occur naturally. However, these metals pose no unaccepable risk to human health and the environment and are no a threat to ground water.

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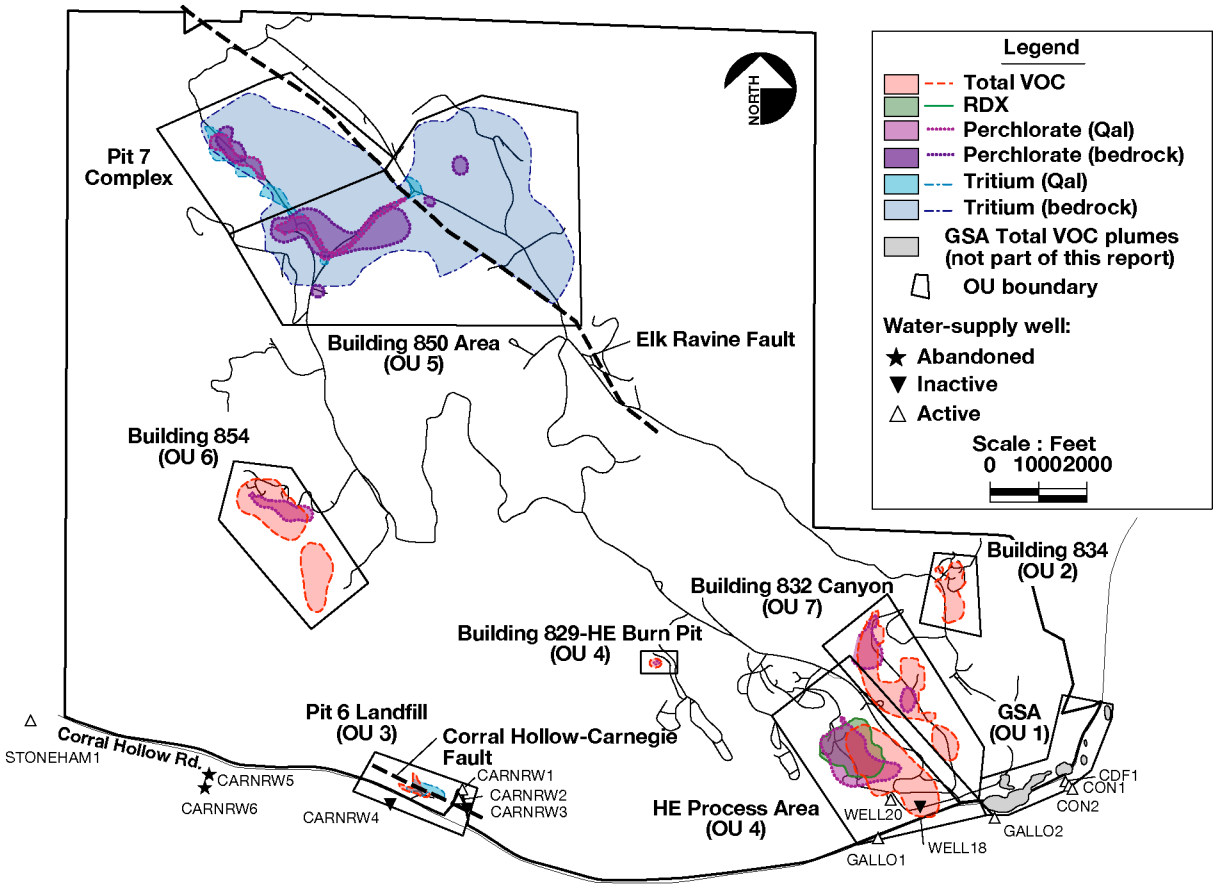

Figure 4. Map of Site 300 showing operable units with ground water plume outlines and operational water-supply wells.

What are the risks from contamination?

A *baseline risk assessment* was conducted for Site 300 to identify potential exposure pathways for people, plants, and animals that must be addressed by the cleanup actions. Risk assessments predict the magnitude, if any, of adverse health effects. The Site 300 baseline risk assessment evaluated risks that would exist if no cleanup took place.

For *carcinogens*, risk for humans is expressed as the probability of developing cancer over a lifetime. For example, an additional cancer risk of one in one million (10^{-6}) means that a person exposed to a specified concentration of that chemical over the course of a lifetime could potentially increase their cancer risk by one in one million. An excess cancer risk between one in ten thousand (10^{-4}) to one in one million (10^{-6}) is considered acceptable by the U.S. EPA. However, the 10^{-6} risk level is the point of departure for determining cleanup levels. For noncarcinogens, a *Hazard Index* is calculated. Hazard Indices less than one are considered protective.

Baseline human health risks and hazards for Site 300 were estimated using adult onsite industrial exposure and offsite residential exposure scenarios. The onsite industrial exposure scenario estimates health risk where an adult is presumed to work in the immediate vicinity of worst-case contamination 8 hours a day, 5 days a week, over a 30 year period of employment at the site. The residential exposure scenario estimates the risk associated with the ingestion of ground water if a family were to install a water-supply well at the site boundary.

Risk estimates for most release sites and contaminants were well below the thresholds designated as being protective by the U.S. EPA. Onsite risks above these thresholds were generally associated with workers potentially inhaling VOCs or tritium volatilizing from the subsurface, or ingesting, inhaling, or directly contacting PCBs, dioxins, and furans in the soil. Many of the risks have already been eliminated by the interim cleanup actions.

There are no past or current offsite exposures to contaminants at Site 300. Therefore, there is no public health hazard to residents near the site.

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The Site 300 ecological assessment evaluated the potential for adverse impact to plants and animals from long-term exposure to contaminants. The ecological assessment focused on potential reproductive damage and reductions in reproductive life span rather than the risk of developing cancer. The ecological risk assessment identified potential impacts to several animal species at Site 300 in surface and shallow subsurface soil. There were no ecological risks associated with surface water. LLNL wildlife biologists closely monitor potentially impacted species as part of a continuing ecological risk management program at Site 300 and have found no adverse effects due to contamination.

The specific risk to onsite workers and potential impacts to animals identified for each OU are discussed in the "Proposed Final Cleanup Action" section.

Interim Cleanup Actions

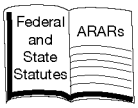
The Interim Site-Wide Proposed Plan (May 2000) and the Interim Proposed Plan for Environmental Cleanup at the Pit 7 Complex (March 2006) compared remedial alternatives for each OU against the nine EPA evaluation criteria (see Figure 5): (1) protection of human health and the environment, (2) compliance with applicable or relevant and appropriate requirements, (3) long-term effectiveness and permanence, (4) reduction in toxicity, mobility, and volume through treatment, (5) short-term effectiveness, (6) implementability, (7) cost, (8) state acceptance, and (9) community acceptance. Based on this evaluation, DOE and the U.S. EPA selected the interim cleanup actions and the State of California RWQCB and DTSC concurred with the selection. The *interim cleanup remedies* for OUs 2 through 8 are documented in the 2001 Interim Site-Wide ROD and the January 2007 Amendment to the Interim Site-Wide ROD for the Pit 7 Complex and are discussed by OU in the "Proposed Final Cleanup Action" section of this Proposed Plan.

Each alternative was assessed against the first eight CERCLA evaluation criteria described below. Using results of this assessment, DOE/LLNL, and the regulatory agencies compared the alternatives and selected a preferred alternative. Community acceptance will be addressed after public comments have been received.

Threshold Criteria

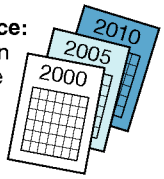
1. **Overall Protection of Human Health and the Environment:** Addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs):** Addresses whether a remedy will meet all ARARs of Federal and State environmental statutes.

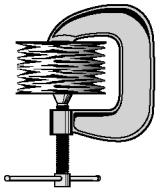


Balancing Criteria

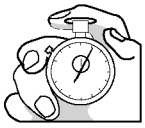
3. **Long-term Effectiveness and Permanence:** Refers to the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.



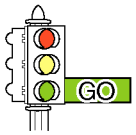
4. **Reduction of Toxicity, Mobility, or Volume Through Treatment:** Refers to the anticipated ability of a remedy to reduce the toxicity, mobility, or volume of the hazardous components present at the site.



5. **Short-term Effectiveness:** Addresses the period of time needed to complete the remedy, and any adverse impact on human health and the environment that may be posed during the construction and implementation period.



6. **Implementability:** Refers to the technical and administrative feasibility of a remedy, including the availability of materials and services needed to carry out a particular option.



7. **Cost:** Evaluates the estimated capital, and operation and maintenance costs of each alternative.

State/Community Acceptance Criteria

8. **State Acceptance:** Indicates whether, based on its review of the information, the State concurs with, opposes, or has no comment on the preferred alternatives.

9. **Community Acceptance:** Indicates whether community concerns are addressed by the remedy and whether the community has a preference for a remedy.

Figure 5. EPA Evaluation Criteria.

Definition or descriptions of *italicized* words are provided in the Glossary on page 16.

Interim Remedial Design documents have been completed for OUs 2 through 7, with the exception of the remedial design for the Pit 7 Complex that is scheduled for 2008. No remedial design is required for OU 8. A final ROD and Remedial Design was completed for OU 1. Cleanup actions have already been initiated at all Site 300 OUs (Figure 6) including:

- Operating 21 ground water and soil vapor extraction and treatment facilities (ongoing).
- Capping and closing four landfills, six HE rinsewater lagoons, and one HE burn pit.
- Removal and/or closure of numerous dry wells throughout the site.
- Removal of contaminated soil from source areas (ongoing).
- The installation and sampling of over 650 ground water monitoring wells to track plume migration and remediation progress (ongoing).

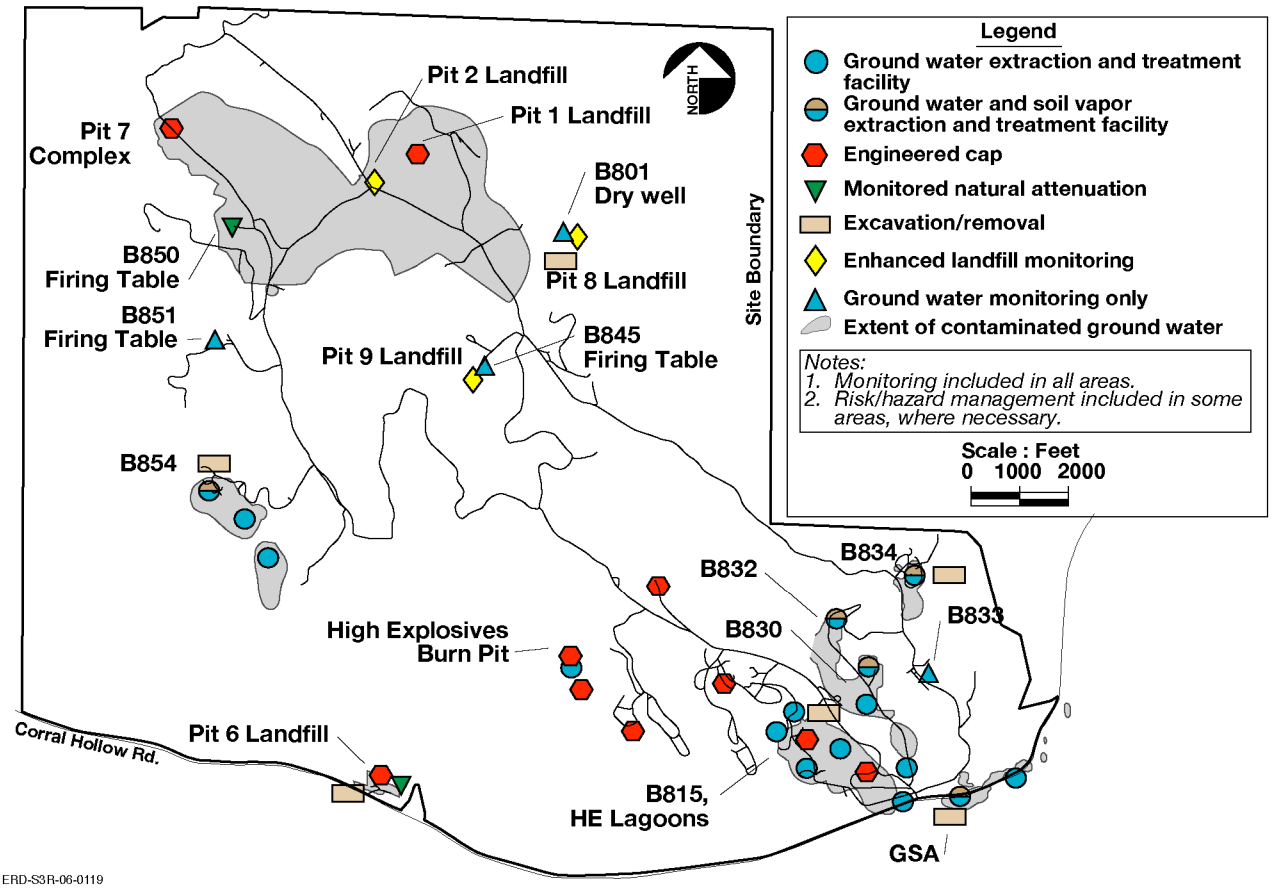


Figure 6. Cleanup remedies implemented at Site 300.

Cleanup Actions for Site 300 cleanup

General Response Actions mitigate potential exposure to, control the migration of, monitor, and/or remediate contaminants. The types of General Response Actions included in the cleanup remedies for OUs 2 through 8 are:

Ground Water and Surface Water Monitoring
Samples of ground and surface water are routinely collected and analyzed to track changes in concentration and distribution of contaminants in ground and surface water to ensure there is no impact to downgradient water-supply wells and to evaluate the effectiveness of the selected cleanup method in meeting remedial action objectives and achieving the cleanup standards.

Risk and Hazard Management
The overall goals of risk and hazard management are to control exposure to contaminants and to ensure the remedy protects human health and the environment. Institutional/land use controls, such as restricting access to areas of contamination and measures to prevent people from drinking contaminated ground water, are the basis of risk management. While DOE is evaluating the consolidation of activities throughout the DOE complex that could result in changes to activities conducted at Site 300, DOE control of the site and site access restrictions

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currently in place (fencing and security patrols) are expected to continue for the foreseeable future. There are no plans to release the land for recreational or residential uses or development. If Site 300 is ever transferred in the future, DOE will execute a land use covenant at that time. If the land use changes, the cleanup remedies and standards would be reviewed to ensure they are consistent with its intended use in accordance with Federal and State laws.

Ground Water Extraction and Treatment
Extraction consists of pumping contaminated ground water from specially designed wells, then treating it to remove contaminants before discharge to the ground or reinjecting back into the subsurface. The extracted water can be treated using granular activated carbon, bioreactors, or ion-exchange systems, depending on the contaminant. The objectives of extraction may include reducing the amount and concentration of contamination, stopping the spread of contaminants, reducing risk, and/or restoring beneficial uses of ground water. There is no cost-effective technology available to remove tritium from water and bringing tritiated water to the surface could result in increased risk to humans.

Soil Vapor Extraction and Treatment
Contaminated vapors in the soil above the water table are pumped from special wells and treated using granular activated carbon to remove contaminants before discharging the cleansed air to the atmosphere. This technology is effective only for volatile contaminants, such as TCE. Soil vapor extraction is often combined with ground water extraction.

Monitored Natural Attenuation
Monitored natural attenuation allows contaminants to degrade naturally in the environment. For this approach to be implemented, appropriate long-term monitoring must be conducted, there must be no active source of contamination, and human health and the environment must be protected. A monitored natural attenuation remedy must also achieve cleanup in a timeframe comparable to active remediation. For example, this method has proven effective for *radionuclides* with short half-lives, such as tritium where there is no other proven technology for treatment. The half-life of tritium is 12.3 years, which means that the amount of tritium in ground water is reduced by 50% every 12.3 years due to radioactive decay. This method can also be effective for nitrate and VOCs.

Surface Soil Removal/Excavation
Excavation is a common method of removing contaminated surface soil by conventional earth-moving equipment. Excavated material can be treated onsite or transported to an appropriate waste disposal facility.

Hydraulic Drainage Diversion
An engineered drainage diversion system consists of interceptor trenches composed of *French drains*, horizontal wells, and shallow terrace drains. The engineered drainage system would prevent ground water from rising into the waste in the Pit 7 Complex landfills and underlying contaminated bedrock by reducing the volume of rainwater that infiltrates and reaches the aquifer beneath the landfills.

Proposed Final Cleanup Actions

In 2006, a Site-Wide Remediation Evaluation Summary report was prepared to:

- Assess the effectiveness and protectiveness of the interim remedies and their suitability as final remedies for OUs 2 through 8.
- Identify any deficiencies in the interim remedies in their effectiveness, protectiveness, and/or ability to meet remedial action objectives and applicable, relevant, or appropriate environmental laws and regulations.
- Propose changes to the remedies, as needed to address any deficiencies.

This remediation evaluation provided the basis for identifying proposed final remedies for OUs 2 through 8 at LLNL Site 300. In addition, an interim remedy for the Pit 7 Complex was selected in an Amendment to the Site-Wide Interim Record of Decision in January 2007. This section describes the extent of contamination, interim remedy that was implemented, cleanup progress, and the proposed final remedy for each OU.

General Services Area (OU 1)

Past disposal of degreasing solvents caused VOC contamination in the subsurface. A ROD for this OU was signed in 1997, and extraction and treatment of VOCs in ground water and soil vapor is underway. Significant progress has been made in the cleanup of contamination in the GSA OU. Remediation has already reduced VOCs in ground water to meet cleanup standards in the Eastern GSA. Since the final cleanup strategy has been implemented for this OU, it is not discussed further in this Proposed Plan other than to detail the Institutional/Land Use Controls in Table 1.

Building 834 (OU 2)

Extent of contamination - Past TCE spills have resulted in contamination of the subsurface soil and rock and a shallow perched water-bearing rock layer or *aquifer*. Other ground water contaminants include nitrate and silicone oils. The deeper regional aquifer has not been affected. The baseline risk assessment identified a risk to onsite workers who could inhale VOCs evaporating from subsurface soil to air at Building 834. It also identified potential impacts to animals from VOCs in subsurface soil and cadmium in surface soil.

Interim remedy:

1. Monitor soil vapor and ground water to evaluate the effectiveness of the remedy in achieving cleanup standards.
2. Risk and hazard management to prevent onsite workers exposure to VOCs volatilizing from subsurface soil and impacts to animals until risk and hazard is mitigated through active remediation.

Definition or descriptions of *italicized* words are provided in the Glossary on page 16.

Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Table 1).

3. Extract and treat soil vapor and ground water to mitigate risk and hazards posed by VOCs in the subsurface soil and reduce VOC, nitrate, and TBOS concentrations in soil and ground water to cleanup standards.
4. Continue evaluating innovative technologies to expedite cleanup.

	Operable Units								
Institutional/land use controls	1 (GSA)*	2 (B834)	3 (Pit 6 Landfill)	4 (HE Process Area)	5 (B850)	5 (Pit 7 Complex)	6 (B854)	7 (B832 Canyon)	8 (Site-Wide)
Prevent water-supply use/consumption of contaminated ground water until ground water cleanup standards are met.	✓	✓	✓	✓	✓	✓	✓	✓	✓ (Buildings 801, 833)
Maintain building occupancy and/or land use restriction to prevent onsite site worker inhalation exposure to VOCs until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	--	✓	--	--	--	--	✓	✓	--
Maintain engineering controls to prevent onsite site worker inhalation exposure to VOCs inside building until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	--	--	--	--	--	--	--	--	✓ (Building 833)
Control excavation activities to prevent onsite worker exposure to contaminants in subsurface soil until it can be verified that concentrations do not pose an exposure risk to onsite workers.	✓	✓	--	✓	✓	✓	✓	✓	✓ (Buildings 801, 833, 845, 851)
Maintain the integrity of the landfill cover as long as the pit waste remains in place.	--	--	✓	--	--	✓	--	--	✓ (Pits 2, 8, 9)
Control construction/ground-breaking activities on the landfill to prevent damage and inadvertent exposure to pit waste as long as the waste remains in place.	--	--	✓	--	--	✓	--	--	✓ (Pits 2, 8, 9)
Maintain access restrictions to prevent inadvertent exposure of onsite workers to the pit waste as long as the waste remains in place.	--	--	✓	--	--	✓	--	--	✓ (Pits 2, 8, 9)
Maintain access restrictions to prevent inadvertent exposure of unauthorized trespassers to the pit waste as long as the waste remains in place.	--	--	✓	--	--	✓	--	--	✓ (Pits 2, 8, 9)
Maintain land use restrictions in the vicinity of Building 850 Firing Table until remediation of PCB-, dioxin-, and furan-contaminated soil reduces the risk to onsite workers to less than 10^{-6}.	--	--	--	--	✓	--	--	--	--
Maintain access restrictions in the vicinity of contaminated springs until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	--	--	✓	✓	--	--	--	✓	--
Prohibit transfer of lands with unmitigated contamination that could cause potential harm under residential or unrestricted land use.	✓	✓	✓	✓	✓	✓	✓	✓	✓

* The GSA was included in the table for completeness.

Table 1. Institutional/land use controls for Site 300 Operable Units

Definition or descriptions of *italicized* words are provided in the Glossary on page 16.

Remediation progress - Some TCE-contaminated soil was removed in 1983. Ground water and soil vapor have been pumped from the subsurface and treated since 1993 to address risk to onsite workers and remove contaminants. Cleanup activities have reduced: (1) VOCs in shallow perched ground water from pre-remediation concentrations of over 1,000,000 micrograms per liter (μg/L) to 32,000 μg/L in 2005, (2) VOC concentrations in soil vapor from 3,000 parts per million (ppm) to 200 ppm, and (3) risk to onsite workers from the inhalation of VOCs in outdoor ambient air to safe levels. Additional sampling and analysis indicate that there is no hazard to animals associated with VOCs in subsurface soil and cadmium in surface soil. Innovative technologies are also being tested at Building 834 to accelerate cleanup.

Proposed final remedy - No deficiencies in the overall approach specified in the interim remedy for the Building 834 OU were identified during the remediation evaluation and the cleanup is progressing as expected to meet cleanup standards. No additional information was identified that would call the protectiveness of the interim remedy into question. Therefore, continuing the interim remedy for the Building 834 OU is proposed as the final remedy.

The proposed final remedy for the Building 834 OU is expected to be protective of human health and the environment upon completion, and in the interim because: (1) ground water and soil vapor extraction and treatment are reducing contaminant concentrations and exposure risk to meet cleanup standards, and (2) institutional/land use controls are in place to prevent exposure to contaminated media until remediation is complete.

Because contaminants in low-permeability sediments could significantly extend the time until cleanup standards are achieved in this OU, DOE will continue to evaluate innovative technologies to expedite cleanup.

Pit 6 Landfill (OU 3)

Extent of contamination - From 1964 to 1973, approximately 1,900 cubic yards of laboratory and shop debris and biomedical waste were placed in nine unlined debris trenches and animal pits at the Pit 6 Landfill. *Plumes* of VOCs and tritium in ground water originate from the landfill. Perchlorate and nitrate have also been detected in ground water. No contaminants of concern were identified in surface or subsurface soil. The baseline risk assessment identified a risk to onsite workers who could inhale VOCs evaporating from the pit waste and Spring 7 to air. It also identified potential impacts to burrowing animals from VOCs in subsurface soil.

Interim remedy:

1. Monitor ground water and surface water to evaluate the effectiveness of the remedy in achieving cleanup standards and to ensure there is no impact to downgradient water-supply wells.
2. Risk and hazard management to prevent onsite workers exposure to VOCs volatilizing from Spring 7 and impacts to animals until risk and hazard is mitigated. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Table 1).
3. Monitored natural attenuation to reduce VOC and tritium concentrations in ground water to cleanup standards.

Remediation progress - An engineered cap was installed on the Pit 6 Landfill in 1997 as a removal action before the Interim ROD to prevent infiltrating precipitation from further leaching contaminants from the buried waste. It also eliminated the risk to onsite workers who could inhale vapors evaporating from the landfill. Natural attenuation has reduced TCE concentrations in ground water from an historical maximum of 250 μg/L to near or below the drinking water standard of 5 μg/L. Concentrations of all other VOCs have been reduced to below the drinking water standard or background levels. The hazard to burrowing animals associated with VOCs in subsurface soil has also been eliminated. Current maximum tritium levels (1,100 picoCuries per liter [pCi/L]) in ground water are well below the drinking water standard (20,000 pCi/L) and continue to decrease. Perchlorate and nitrate are being monitored due to their limited extent in ground water. In 2005, nitrate was detected in only one *monitor well* above the drinking water standard of 45 milligrams per liter (mg/L) and perchlorate was detected in one monitoring well above the California Public Health Goal of 6 μg/L.

Proposed final remedy - No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Pit 6 Landfill OU and the cleanup is progressing as expected to meet cleanup standards. No additional information was identified that would call the protectiveness of the interim remedy into question. Therefore, continuing the interim remedy for the Pit 6 Landfill OU is proposed as the final remedy.

The proposed final remedy is expected to be protective of human health and the environment upon completion, and in the interim because: (1) the contaminant source in the landfill has been controlled to prevent further releases, (2) VOC and tritium concentrations in ground water are near or below cleanup standards and natural attenuation is continuing to reduce contaminant concentrations, and (3) institutional/land use controls are in place to prevent exposure to contaminated media until remediation is complete.

High Explosives Process Area (OU 4)

Extent of Contamination - Surface spills occurred at the drum storage and dispensing area for the former Building 815 steam plant, where TCE was used to clean pipelines. These spills resulted in the release of TCE and other VOCs to ground water and subsurface soil and bedrock. HE compounds, nitrate, and perchlorate have also been detected in ground water and are likely the result of wastewater discharges to former unlined rinsewater lagoons. Similar contaminants were also found in ground water near the former HE Burn Pits.

Definition or descriptions of *italicized* words are provided in the Glossary on page 16.

The baseline risk assessment identified a risk to onsite workers who could inhale VOCs evaporating from subsurface soil to air at Building 815 and surface water at Spring 5.

Interim Remedy:

1. Monitor ground water to evaluate the effectiveness of the remedy in achieving cleanup standards, and to ensure there is no impact to downgradient water-supply wells.
2. Risk and hazard management to prevent onsite worker exposure to VOCs volatilizing from subsurface soil and Spring 5 until risk and hazard are mitigated through active remediation. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Table 1).
3. Extract and treat VOCs, HE compounds, nitrate, and perchlorate in ground water to mitigate unacceptable VOC inhalation risk for onsite workers, prevent further impacts to ground water and offsite plume migration, and reduce contaminant concentrations in ground water to cleanup standards.

Remediation Progress - The former HE rinsewater lagoons and HE burn pit were capped and closed in 1989 and 1998, respectively, to prevent further contaminant releases. Six ground water extraction and treatment systems are in place and operating to remove contaminants from the subsurface. Ground water cleanup activities that began in 1999 have reduced TCE in ground water from pre-remediation concentrations of over 110 μg/L to 51 μg/L in 2005. Remediation has also reduced the risk to onsite workers from the inhalation of VOCs in outdoor ambient air to safe levels.

Proposed Final Remedy - No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the HE Process Area OU and the cleanup is progressing as expected to meet cleanup standards. No additional information was identified that would call the protectiveness of the interim remedy into question. Therefore, continuing the interim remedy is proposed as the final remedy.

The only recommended changes for the final remedy are:

- DOE proposes monitored natural attenuation as a health-protective, cost-effective final remedy component for nitrate in ground water because natural processes convert nitrate in ground water to harmless nitrogen gas.
- Institutional controls (access restrictions) at Building 815 are no longer needed to prevent onsite worker exposure to VOCs because this risk has been eliminated.

The proposed final remedy is expected to be protective of human health and the environment upon completion, and in the interim because: (1) ground water extraction and treatment of VOCs and perchlorate and natural attenuation of nitrate are reducing contaminant concentrations and exposure risk to meet cleanup standards and (2) institutional/land use controls are in place to prevent exposure to contaminated media until remediation is complete.

Building 850 (OU 5)

Extent of Contamination - Historical firing table experiments at Building 850 resulted in releases of contaminants to soil and ground water. Experimental procedures have since been modified to prevent further contaminant releases. Uranium, tritium, nitrate and perchlorate are contaminants of concern in ground water. Tritium, uranium, HE compounds, metals, PCBs, dioxins, and furans were found in surface soil near the Building 850 Firing Table. The baseline risk assessment identified a risk to onsite workers who could inhale, ingest, or contact PCBs, dioxins, or furans in surface soil in the vicinity of the firing table. It also identified a hazard to animals that could be exposed to this soil contamination

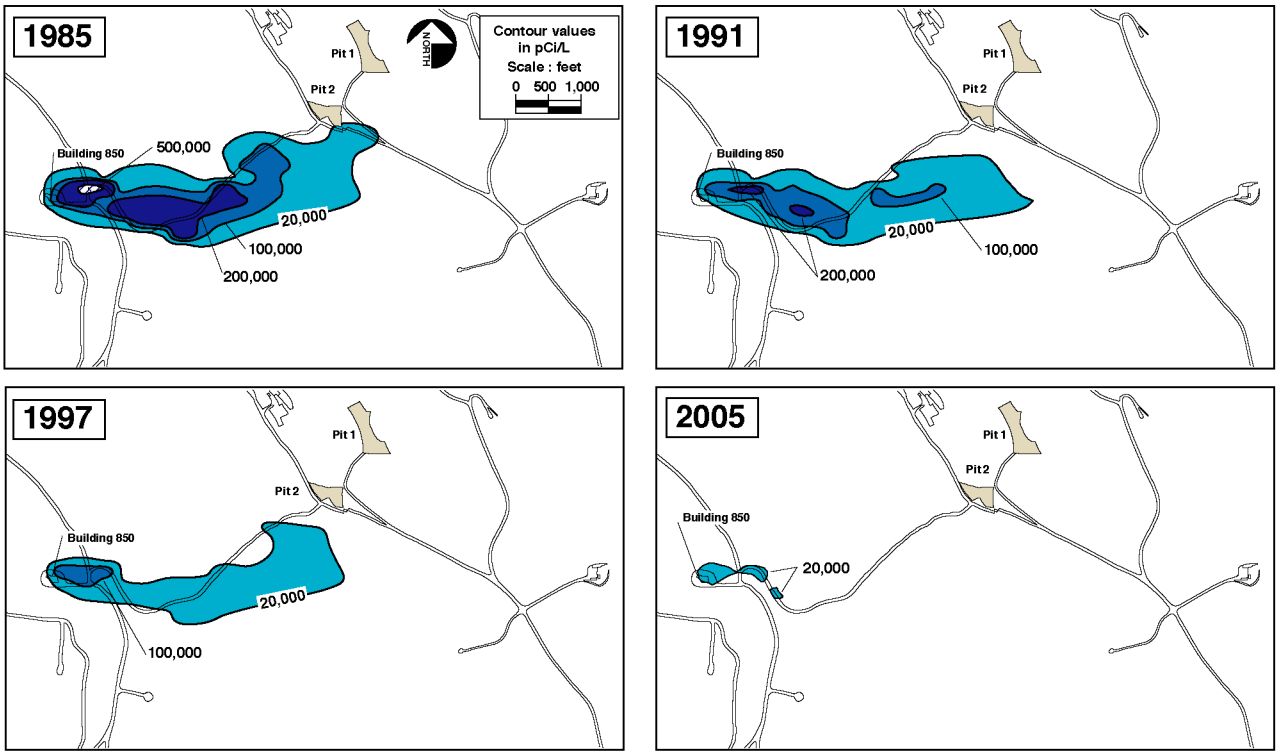
Interim Remedy:

1. Monitor ground water and surface water to evaluate the effectiveness of the remedy in achieving cleanup standards.
2. Risk and hazard management to prevent onsite worker and animal exposure to PCBs, dioxins, and furans in surface soil until risk and hazard is mitigated through active remediation. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Table 1).
3. Excavate and dispose of contaminated soil and sandpile at the firing table to mitigate risk and hazard to onsite workers and animals.
4. Monitored natural attenuation to reduce tritium activities in ground water and surface water to cleanup standards.

Active measures for nitrate in ground water were not included because: (1) data indicate the presence of a significant natural source of nitrate in the Building 850 area, (2) the extent of nitrate with concentrations exceeding the *Maximum Contaminant Level* (MCL) is limited and does not pose a threat to human health or the environment. In addition, no active remediation for uranium in ground water was included because total uranium activities are below the MCL and the extent of uranium is limited.

Remediation Progress - PCB-contaminated shrapnel from explosive experiments around the firing table was removed in 1998. Tritium activities in ground water have steadily decreased over a 20-year period from a maximum of over 500,000 pCi/L to less than 100,000 pCi/L, indicating that natural attenuation of tritium is occurring. As shown in Figure 7, the size of the tritium plume above the drinking water standard has shrunk from approximately one mile in length to 1,200 feet. Uranium has not been detected in ground water at concentrations above the MCL.

Proposed Final Remedy - No deficiencies in the interim remedy for ground water were identified in the evaluation of the remediation approach for Building 850



ERD-S3R-06-0055

Figure 7. Extent of ground water tritium plume in the Building 850 subarea from 1985 to 2005 at concentrations exceeding the 20,000 pCi/L drinking water standard.

and the cleanup is progressing as expected to meet cleanup standards. No changes are proposed to the ground water cleanup strategy and continuing the interim remedy is proposed as the final remedy.
However, based on the recent identification of perchlorate in ground water, DOE will implement an *in situ* bioremediation treatability study for perchlorate in ground water and discuss possible remedial measures with the regulatory agencies. Public input will be solicited prior to the selection of any remedial action for perchlorate in ground water.

A proposed final remedy for PCB-, dioxin-, and furan-contaminated soil is not included the Site-Wide Proposed Plan and Final ROD because DOE and the regulatory agencies have agreed to conduct remediation of this soil as a non-time critical Removal Action. DOE will evaluate a remedy for contaminated soil in the firing table area in an Engineering Evaluation/Cost Analysis document in 2007. The remediation method to be implemented will be selected in an Action Memorandum scheduled for 2008. Public input will be solicited prior to the selection of the remedial action for this contaminated soil.

The proposed final remedy is expected to be protective of human health and the environment upon completion, and in the interim because: (1) natural attenuation of tritium is reducing contaminant activities to meet cleanup standards, (2) total uranium activities in Building 850 ground water remain below the 20 pCi/L MCL and the extent of *depleted uranium* in ground water has not changed, (3) nitrate in ground water does not pose a threat to human health or the environment, and (4) institutional/land use controls are in place to prevent exposure to contaminated media until remediation is complete.

Pit 7 Complex (OU 5)

Extent of Contamination - From 1958 until 1988, debris from explosive tests conducted at Site 300 firing tables was disposed in unlined landfill Pits 3, 4, 5, and 7 at the Pit 7 Complex. The waste placed in the pits included wood; plastic; material and debris from tent structures; pea gravel; and exploded test assemblies that frequently contained tritium and depleted uranium. During years of above-normal rainfall (i.e., 1997-1998 El Niño), ground water rose into the bottom of the landfills and the underlying bedrock. This resulted in the release of tritium, uranium, VOCs, perchlorate, and nitrate to ground water in the Pit 7 Complex area. A risk to onsite workers who could inhale tritium evaporating from subsurface soil in the vicinity of Pit 3 Landfill was identified.

Interim Remedy:

1. Monitor ground water and surface water to evaluate the effectiveness of the remedy in achieving cleanup standards.
2. Risk and hazard management to prevent onsite

workers exposure to tritium volatilizing from subsurface soil in the vicinity of Pit 3 Landfill until risk and hazard is mitigated. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Table 1).
3. Monitored natural attenuation to reduce tritium activities in ground water and surface water to cleanup standards.
4. Install an engineered drainage diversion system to hydraulically isolate the contaminant sources in the landfills and underlying bedrock from subsurface water, thereby preventing infiltration of rainwater runoff that can result in ground water rising into Pits 3, 4, 5, and 7 and releasing contaminants.
5. Extract and treat ground water to reduce uranium, perchlorate, nitrate, and VOC concentrations in ground water to meet cleanup standards.

Remediation Progress - The interim remedy was selected in January 2007 and has not yet been implemented.

Proposed Final Remedy - The interim remedy is proposed as the final remedy.

The proposed final remedy is expected to be protective of human health and the environment upon completion, and in the interim because: (1) natural attenuation of tritium is reducing contaminant activities to meet cleanup standards, (2) ground water extraction and treatment will reduce contaminant concentrations to meet cleanup standards, and (3) institutional/land use controls are in place to prevent exposure to contaminated media until remediation is complete.

Building 854 (OU 6)

Extent of Contamination - TCE was used as a heat-exchange fluid, and was released to soil and ground water as a result of past activities conducted at Building 854. Nitrate and perchlorate have also been detected in ground water. HE compounds, PCBs, dioxins, furans, tritium, and metals have been detected in surface soil. A risk was identified for onsite workers who could inhale, ingest, or contact PCBs, dioxins, or furans in surface soil in the former Building 855 rinsewater lagoon or inhale VOCs evaporating to air from subsurface soil at Buildings 854A and 854F. A hazard to animals that could be exposed to PCB soil contamination was also identified.

Interim Remedy:

1. Monitor ground water to evaluate the effectiveness of the remedy in achieving cleanup standards.
2. Risk and hazard management to prevent onsite worker and animal exposure to VOCs volatilizing from subsurface soil and PCBs, dioxins, and furans in surface soil until risk and hazard are mitigated through active remediation. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Table 1).
3. Extract and treat VOCs in soil vapor and ground water, and nitrate and perchlorate in ground water to mitigate unacceptable VOC inhalation risk for onsite workers, prevent further impacts to ground water, and reduce contaminant concentrations in ground water to cleanup standards.
4. Excavate and dispose of the PCB-, dioxin-, and furan-contaminated soil in the former Building 855 lagoon to mitigate risk and hazard to onsite workers and animals.

Remediation Progress - Some TCE-contaminated soil was excavated in 1983. Contaminated soil containing PCBs, dioxins, and furans was excavated in 2005, mitigating the risk to onsite workers and animals. Ground water remediation has been underway since 1999. Soil vapor extraction and treatment began in 2005. Cleanup activities have reduced TCE in ground water from pre-remediation concentrations of over 2,900 μg/L to 180 μg/L in 2005 and reduced the risk to onsite workers from the inhalation of TCE in at Building 854F to safe levels.

Proposed Final Remedy - No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Building 854 OU and the cleanup is progressing as expected to meet cleanup standards. No additional information was identified that would call the protectiveness of the interim remedy into question. Therefore, continuing the interim remedy is proposed as the final remedy.

The only recommended change for the final remedy is that institutional controls are no longer needed to prevent onsite worker or animal exposure to PCBs, dioxins, and furans in soil because this hazard has been eliminated.

The proposed final remedy for the Building 854 OU is expected to protect human health and the environment upon completion, and in the interim because: (1) ground water extraction and treatment are reducing contaminant concentrations to meet cleanup standards and (2) institutional/land use controls are in place to prevent exposure to contaminated media until remediation is complete.

Building 832 Canyon (OU 7)

Extent of Contamination - Contaminants were released from Buildings 830 and 832 through piping leaks and surface spills during past activities at these buildings. VOCs, nitrate, and perchlorate have been detected in ground water. VOCs, nitrate, and HE compounds have been detected in subsurface soil. HE compounds have also been detected in surface soil. The baseline risk assessment identified a risk to onsite workers who could inhale VOCs evaporating from subsurface soil at Buildings 830 and 832, and from surface water at Spring 3 to air.

Interim Remedy:

1. Monitor ground water to evaluate the effectiveness of the remedy in achieving cleanup standards, and to ensure there is no impact to downgradient water-supply wells.
2. Risk and hazard management to prevent onsite worker exposure to VOCs volatilizing from

subsurface soil until risk and hazard are mitigated through active remediation. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Table 1).

3. Extract and treat VOCs in soil vapor and ground water, and perchlorate, and nitrate in ground water to mitigate unacceptable VOC inhalation risk for onsite workers, prevent further impacts to ground water and offsite plume migration, and reduce contaminant concentrations in soil and ground water to cleanup standards.

Remediation Progress - Ground water and soil vapor have been pumped from the subsurface and treated since 1999 to address risk to onsite workers and remove contaminants. Cleanup activities have reduced VOCs in ground water from pre-remediation concentrations of over 30,000 μg/L to 9,500 μg/L in 2005. Remediation has also reduced the risk to onsite workers from the inhalation of VOCs in outdoor ambient air near Building 830 and indoor ambient air at Building 832F to safe levels.

Proposed Final Remedy - No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Building 832 Canyon OU and the cleanup is progressing as expected to meet cleanup standards. Additional information has been gathered since the Interim ROD that demonstrates that nitrate is being naturally denitrified to nitrogen gas in the Building 832 Canyon OU, similar to the processes occurring in the HE Process Area OU. Therefore, DOE proposes to continue the interim remedy as the final remedy but monitored natural attenuation, instead of extraction and treatment, will be used to reduce nitrate concentrations in ground water to meet cleanup standards.

The proposed final remedy for the Building 832 Canyon OU is expected to protect human health and the environment upon completion, and in the interim because: (1) ground water and soil vapor extraction and treatment are reducing contaminant concentrations to meet cleanup standards, (2) natural attenuation is reducing nitrate concentrations and exposure risk to meet cleanup standards, (3) risk to onsite workers has already been reduced to safe levels, and (4) institutional/land use controls are in place to prevent exposure to contaminated media until remediation is complete.

Because contaminants in low-permeability sediments could significantly extend the time until cleanup standards are achieved in this OU, DOE will continue to evaluate innovative technologies to expedite cleanup.

OU 8 Release Sites: Buildings 801, 833, 845, and 851 Firing Table, and Pits 2, 8, and 9 Release Sites

Operable Unit 8 includes the contaminant release sites that have a monitoring-only interim remedy: Building 801 Dry Well and Pit 8 Landfill, Building 833, Building 845 and Pit 9 Landfill, Building 851 Firing Table, and Pit 2 Landfill. Operable Unit 8 release sites have a monitoring-only interim remedy because either: (1) contaminants in surface and subsurface soil/bedrock do not pose a risk to humans or plant and animal populations or a threat to ground water, (2) there is no ground water contamination, (3) contaminant concentrations in ground water do not exceed regulatory standards, and/or (4) the extent of contamination in ground water is limited.

Extent of Contamination and Remediation Progress at the OU 8 Release Sites

Building 801 and the Pit 8 Landfill

The Building 801 Firing Table was used for explosives testing, and operations resulted in contamination of adjacent soil with metals and uranium. Use of this firing table was discontinued in 1998, and the firing table gravel and some underlying soil were removed. Waste fluid discharges to the Building 801 Dry Well resulted in low concentrations of VOCs in soil and ground water. There is no risk to humans or animals associated with this contamination. Debris from the firing table was buried in the nearby Pit 8 Landfill until 1974.

The Building 801 Dry Well was decommissioned and filled with concrete in 1984. VOC concentrations in the location of the former Building 801 dry well have decreased from a historical maximum of 10 μg/L in 1990 to below drinking water standards in 2005. No contaminants have been detected in ground water under the Pit 8 Landfill.

Building 833

TCE was used as a heat-exchange fluid at Building 833. Surface discharge of waste fluids caused TCE-contamination of soil and shallow perched ground water. No contamination has been detected in the deeper regional aquifer. The baseline risk assessment identified a risk to onsite workers who could inhale VOCs evaporating from subsurface soil to air at Building 833. Engineered controls were implemented at Building 833 to prevent worker exposure to VOCs until the risk is reduced to safe levels. Ground water monitoring performed in the vicinity of Building 833 has shown a decline in VOC concentrations from a historical maximum of 2,100 μg/L in 1990 to 7.5 μg/L in 2005.

Building 845 and the Pit 9 Landfill

The Building 845 Firing Table was used until 1963 to conduct explosives experiments. As a result, subsurface soil is contaminated with uranium and high explosives. There is no risk to humans or animals or threat to ground water associated with this contamination. Debris generated at the Building 845 Firing Table was buried in the Pit 9 Landfill. No contaminants have been detected in ground water under the Building 845 Firing Table or Pit 9 Landfill.

Building 851 Firing Table

Explosive experiments at the Building 851 Firing Table contaminated the surrounding soil with RDX and metals,

subsurface soil with depleted uranium and VOCs, and ground water with depleted uranium. Uranium activities in ground water beneath the Building 851 firing table continue to be well below the 20 pCi/L drinking water standard. Recent uranium activities in ground water samples are below the 1.3 pCi/L historical maximum detected in 1991. There is no risk to humans or animals associated with this contamination.

Pit 2 Landfill
The Pit 2 Landfill was used until 1960 to dispose of firing table debris from Building 801 and 802. Recent ground water data indicate that a discharge of potable water to support a red-legged frog habitat located upgradient from the landfill may have leached depleted uranium from the buried waste. There is no risk to humans or animals associated with this contamination. The frogs were relocated and the water discharge was discontinued, thereby removing the leaching mechanism. Ground water monitoring will continue to determine whether depleted uranium continues to be released. Uranium activities in ground water continue to be within levels considered safe for drinking water.

Interim Remedy for OU 8 Release Sites:

1. Monitor ground water to detect any future releases from the Pit 2, 8, and 9 landfills or changes in contaminant concentrations at the OU 8 release sites that could impact human health or the environment.
2. Risk and hazard management to prevent onsite worker exposure to VOCs evaporating from subsurface soil at Building 833 until risk is mitigated. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Table 1).
3. Inspect Pit 2, 8 and 9 landfill covers periodically for damage that could compromise their integrity and repair any damage found.

Proposed Final Remedy for OU 8 Release Sites - No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the OU 8 release sites. No additional information was identified that would call the protectiveness of the interim remedy into question. Therefore, the interim remedy is proposed as the final remedy.

The proposed final remedy for OU 8 release sites is expected to protect human health and the environment upon completion, and in the interim because: (1) contaminants in surface and subsurface soil/bedrock do not pose a risk to humans or plant and animal populations or a threat to ground water, (2) there is no ground water contamination, (3) contaminant concentrations in ground water do not exceed regulatory standards, and/or (4) the extent of contamination in ground water is limited. In addition, institutional/land use and engineered controls prevent exposure to contaminated media.

Proposed Final Cleanup Standards

Ground Water and Surface Water
The proposed cleanup standards for ground water and surface water at LLNL Site 300 Operable Units 2 through 8 are Federal drinking water MCLs unless California State MCLs are more stringent, as shown in Table 2. VOCs and tritium are the only contaminants of concern in surface water (onsite springs) at Site 300.

Because there are no Federal or State MCLs for RDX, DOE has agreed to a proposed ground water cleanup standard of 1 μg/L, the analytical method detection limit for RDX. This cleanup standard was selected because the RDX detection limit is slightly above the EPA Region 9 tap water *Preliminary Remediation Goal* of 0.61 μg/L, therefore the de facto (actual) cleanup standard is the detection limit.

No ground water cleanup standard has been included for TBOS because there are no regulatory standards or health effects for this compound. However, the TBOS in the Building 834 OU is being remediated as part of the VOC cleanup.

As part of the CERCLA process, DOE will prepare a technical and economic feasibility analysis as part of the first Five-Year Review after ground water contaminant concentrations have been reduced to MCLs in each OU (2-8). This analysis will be used to determine the technical and economic feasibility of continuing remediation to further reduce contaminant concentrations to below MCLs. A range of values will be considered down to *water quality numeric limits* or background. The technical and economic feasibility analyses would be reviewed and approved by the RWQCB, DTSC, and EPA. Any changes to ground water cleanup standards would be proposed to the community and take effect through a ROD amendment.

Surface Soil
The Building 850 Firing Table is the only OU that still contains surface soil contamination that poses an unacceptable risk to humans (onsite workers) and animals, and is being cleaned up as a non-time-critical Removal Action. These surface soil contaminants include PCBs, dioxin, and furan compounds. As agreed to in the Interim Site-Wide ROD, cleanup standards for these contaminants of concern in surface soil are the U.S. EPA industrial soil Preliminary Remediation Goals. The Preliminary Remediation Goals for protection of human health are sufficiently low to reduce the hazard to animals to safe levels. There is no threat to ground water posed by PCBs, dioxins, or furans in surface soil at the Building 850 Firing Table. There are no changes to cleanup standards for surface soil that were selected in the Interim Site-Wide ROD.

Subsurface Soil and Rock
No further action was selected in the Interim Site-Wide ROD as the final remedies for all contaminants of concern in subsurface soil/rock in the HE Process Area,

Definition or descriptions of *italicized* words are provided in the Glossary on page 16.

Building 850, and the Site-Wide OUs, and for non-VOC contaminants of concern in subsurface soil/rock in the Buildings 854 and 832 Canyon OUs because there was no risk to humans, plants, or animals, or threat to ground water associated with this contamination.

The Interim Site-Wide ROD specified that cleanup goals for VOC-contaminated subsurface soil at the Building 834, 854, and 832 Canyon OUs be addressed in the Final Site-Wide ROD. Therefore, the proposed cleanup goals for VOCs in subsurface soil/rock in these OUs are to: (1) mitigate risk and hazard to human health (2) reduce VOC concentrations to meet ground water cleanup standards, and (3) prevent further impacts to ground water to the extent technically and economically feasible.

DOE will continue to annually evaluate the reduction in inhalation risk and hazard resulting from VOC vapor transport to indoor air at Buildings 830, 833, 834D, and 854A and to ambient air near Springs 3, 5, and 7. The evaluation of risk and hazard reduction in indoor air will be conducted using a model that simulates evaporation of VOC vapor into a building. The evaluation of risk and hazard reduction in ambient air near springs will be conducted by collecting air samples for VOC analysis and re-evaluation of risks when water is present in the springs. Institutional and/or engineered controls will prevent exposure until unacceptable risks (greater than one-in-a-million cancer risk) are mitigated through remediation. Results of these evaluations will continue to be presented in the Annual Compliance Monitoring Reports.

Contaminant fate and transport modeling, trend analysis, mass balance, and/or other means will be used to determine when the cleanup of VOCs in subsurface soil in the Buildings 834, 854, and 832 Canyon OUs has been achieved (i.e., when remaining VOCs no longer cause concentrations in leachate to exceed the ground water cleanup levels). This determination will include examining the effects of remaining subsurface soil/rock VOC contamination on ground water quality using an appropriate vadose zone model, if necessary. DOE will obtain concurrence from the regulators prior to shutting down any SVE system.

Ground water contaminants of concern	Cleanup standard
Volatile Organic Compounds (VOCs):	
Chloroform	80 micrograms per liter (µg/L) [a]
Cis-1,2-dichloroethylene	6 µg/L [b]
1,2-Dichloroethane	0.5 µg/L [b]
1,1-Dichlorethylene	6 µg/L [b]
Tetrachloroethylene (PCE)	5 µg/L [c]
1,1,1-Trichloroethane	200 µg/L [c]
Trichloroethylene (TCE)	5 µg/L [c]
High Explosive Compounds:	
Research department explosive (RDX)	1 µg/L [d]
Radionuclides:	
Tritium	20,000 picoCuries per liter (pCi/L) [c]
Uranium	20 pCi/L [b]
Other:	
Nitrate (as NO_3)	45 milligrams per liter (mg/L) [c]
Perchlorate	6 µg/L [e]
TBOS (silicone oil)	None [f]

[a] State and Federal MCL for *total trihalomethane*s.
[b] State MCL
[c] State and Federal MCL
[d] No Federal or State MCLs for RDX. Preliminary Remediation Goal is below the detection limit, therefore the de facto cleanup standard is the detection limit.
[e] State of California *Public Health Goal* and proposed MCL.
[f] No Federal or State MCLs for TBOS. To be remediated as part of the VOC cleanup.

Table 2. Proposed cleanup standards for Site 300 ground and surface water.

What Happens Next?

The Final Site-Wide ROD will document the remedies and cleanup standards for Site 300. However, there are remedy review processes that are required following the ROD to evaluate if cleanup is progressing as expected and remains protective of human health and the environment. There are several ways in which the cleanup remedies are reviewed for effectiveness and protectiveness:

- Five-Year Reviews.
- Semi-annual Compliance Monitoring Reports.
- Monthly meetings with regulatory agencies.

A Contingency Plan is also in place so that the remedies can be changed if they are not working as expected. In accordance with CERCLA, if technical evidence indicates that the implemented remedy is not effective, appropriate changes would be proposed.

Who do I contact for more information?

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Where are the information repositories?

Copies of the CERCLA documents for the LLNL Site 300 Environmental Restoration Project are available at:

LLNL Visitors Center
Enter from Greenville Road
Livermore, CA 94551
(925) 422-9797

Tracy Public Library
20 East Eaton Avenue
Tracy, CA 95377
(209) 835-2221

This Proposed Plan is available on the LLNL Environmental Public Information website:
http://www-envirinfo.llnl.gov

Glossary

Applicable or relevant and appropriate requirements (ARARs): CERCLA requires compliance with certain Federal or more stringent State requirements known as ARARs. When a requirement addresses circumstances identical to those at a Superfund site, it is considered applicable. When a requirement is sufficiently similar, it is considered relevant and appropriate.

Aquifer: Rock or soil that is saturated with ground water and is sufficiently permeable to allow the movement of ground water through rock pores spaces or fractures.

Baseline risk assessment: An evaluation of the risk that would be posed to human health and/or the environment by exposure to contaminants at a site if no cleanup activities were performed.

Carcinogen: A substance causing cancer.

CERCLA: The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is a law that authorizes the Federal government to

respond directly to releases of hazardous substances that may endanger public health or the environment.

Contaminants of concern: Chemicals, metals, or radioactive constituents present in surface soil, subsurface soil/rock, surface water, or ground water as a result of site activities that: (1) pose an unacceptable risk to human health or the environment, (2) could impact ground water, or (3) exceed regulatory standards.

French drain: A trench filled with gravel, rock, or perforated pipe that redirects surface or ground water away from an area.

Ground water: Water that is present in pore spaces or fractures in soil or rock.

Hazard index: A summation of the hazard quotients for all chemicals to which an individual is exposed. A hazard index value of less than 1 indicates that no adverse human health effects (noncancer) are expected to occur.

In situ: In natural position or place.

Institutional/Land Use Controls: Administrative or legal mechanisms that protect property users and the public from existing site contamination. These controls are necessary where restricted uses are chosen for a site.

Interim cleanup remedies: Interim remedies are implemented before a final cleanup remedy and/or standards have been selected. At LLNL Site 300, the interim remedies did not include cleanup standards, which are being proposed in this plan.

Leachate: The liquid produced when water percolates through permeable soil or rock that may contain dissolved contaminants.

Maximum Contaminant Level (MCL): Under the authority of the Safe Drinking Water Act, EPA sets standards for 90 contaminants in drinking water. For each of these contaminants, EPA sets a legal limit, called a maximum contaminant level. Water that meets these standards is safe to drink. The State of California has also established MCLs.

Monitor well: Well from which ground water or soil vapor samples are collected and analyzed to determine the presence and concentration of contaminants.

Monitored Natural Attenuation (MNA): A remedial alternative that relies on naturally occurring processes, such as radioactive decay or degradation by microorganisms, to transform hazardous substances to less toxic or non-toxic substances. Contaminants and indicator parameters are monitored to ensure that process continues as expected.

National Priorities List: A list prepared by EPA of national priorities among known releases of hazardous substances or contaminants in the U.S.

Non-fissile: Nuclear materials not capable of sustaining a chain reaction of nuclear fission.

Operable unit: A discrete portion of a site that is investigated and cleaned up separately from other portions of the site.

Plume(s): A plume is formed when contaminants become dissolved in ground water. The dissolved contaminant can then move with ground water. The speed at which a plume migrates depends mainly on the type of contaminant, its physical characteristics, and the type of soil and rock in which it is contained. Site 300 ground water moves approximately 10 to 100 ft per year depending on the geologic formation and location at the site.

Preliminary Remediation Goals: EPA risk-based guidelines for evaluating and cleaning up contaminated sites.

Public Health Goals: Levels of contaminants in drinking water established by the State of California that would pose no significant health risk to people using the water on a daily basis over a lifetime.

Radionuclide: An atom with an unstable nucleus. The radionuclide undergoes radioactive decay by emitting a gamma ray(s) and/or subatomic particles. Radionuclides may occur naturally, but can also be artificially produced. EPA classifies all radionuclides as carcinogens.

Record of Decision: A legal document that is signed by

the site's responsible party (DOE), the U.S. EPA, and the State regulatory agencies that provides the actions for cleaning up a CERCLA Superfund site.

Total Trihalomethanes: The sum of the four chlorine and bromine-containing trihalomethanes (i.e., chloroform, bromodichloromethane, dibromochloromethane, and bromoform). The EPA regulates the sum of these four species on a weight concentration basis.

Water quality numeric limit: Limits or levels of water constituents or characteristics used by the State of California to implement the narrative water quality objectives in the Basin Plan for the protection of the beneficial uses of water.

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